FEYNMAN'S GRAVITY, FACT OR FOLLY

"One very important feature of pseudo forces is that they are always proportional to the masses. The same is true of gravity. The possibility exists therefore that gravity itself is a pseudo force. Is it not possible that perhaps gravitation is due simply to the fact we do not have the right coordinate system?"

Feynman - Lectures on physics

For Richard Feynman, the idea that gravity could be a delusory manifest of some known phenomena seemed to be always with him. In his Lectures on Gravity, he frames the issue thus:[1]

1) Gravitation is a new Field of its own, unlike anything else, or

2) Gravity is a consequence of something already known but incorrectly perceived.

It was Feynman's philosophy that nothing should be dismissed until exhaustively analyzed in terms of known principles. New Physics requires strong evidence. The empirical support for a theory of gravitons congruent with the successful predictions of Einstein's geometric was then, and is today, still missing. In lieu gravitons, perhaps the void can be understood in terms of yet to be discovered dynamical properties. Indeed, some characteristics of space would seem to be ascribable in the jargon of classical physics. Expansion, distortion, and pressure are common descriptors, but in the end, the stuff of space cannot be conceptualized from conventional proclivities.

Feynman referred to forces that result from acceleration as "*pseudo forces*" (instantaneous inertial opposition proportional to the mass).[2] The identity of the structure undergoing acceleration, however, is not specified by Newton's second law. In fact, it would not be inconsistent with the formulation to consider space as accelerating rather than matter. Conservation of momentum then requires that space, must in some manner, exhibit, absorb, and moderate reactionary consequences.[3] In what form might this reversal of roles be manifest?

While working out the theory of General Relativity, Einstein explored the properties the universe must posses to prevent the detection of absolute motion. What followed was the principle of relative acceleration...the force felt by the crew of an accelerating rocket ship is no different than that experienced by the same crew at rest in a universe undergoing unidirectional acceleration. It was a bold but safe objectification of space, at the time, not capable of validation or falsification. How might this pseudo force be recognized? The answer would come with the discovery of cosmological expansion. Accelerating objects feel inertial reactions as pseudo forces. Likewise, the inertial reaction of a material object subjected to an acceleration creating expansion field should distort the causal dynamic. Local **g** fields are pseudo force reflexion(s) of spatial expansion.

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[1]Feynman, Lectures on Gravity, Lecture 1, §1.5

[2]Feynman, Lectures on Physics, Vol I, §12-5

[3]'Understanding Physics, Isaac Asimov, Barns and Noble 1993. Mechanism at pages 115-120: In working out the Theory of General Relativity, Einstein explored the properties the universe must have to prevent the determination of absolute motion in the case of accelerating reference frames. What followed was the concept of relative acceleration.

As Einstein foretold, gravitational and inertial mass are one-in-the-same. Inertial reaction determines the force acting upon accelerated masses as well as the masquerading '**g**' field that appears to emanate from local masses. A mass at rest in an accelerating cosmos feels the same pseudo force as a mass accelerated with respect to the inertial frame of the cosmos. But for gravity to be a pseudo force within Feynman's denotation, it will be necessary to identify the coordinate system and quantify the rate of acceleration.

What is known with reasonable certainty is that cosmic expansion is isotropic. Any uniform spherical mass far removed from other matter will be subjected to uniform spatial divergence. Because matter is composed of particles held together by strong electric and quantum forces, condensed forms of energy are not disassociated or expanded by spatial expansion. Non-expanding densities thus satisfy as local centers for pseudo force coordinate systems.

The concepts of mass, gravity and space are intimately entwined.[4] Most astronomical velocities are small compared to the velocity of light.[5] Newton's second law thus applies without correction to forces and accelerations relating local inertial reaction to gravitational action. We will thus find easy mathematical constructs for relating gravity and inertia to the same mass factor. Here it would seem that an explanation of mass would be appropriate, it being the crux upon which our story is based.[6] For the present, we defer the question as to the origin of mass *a la* Mach as well all other theories contrived to explain inertia, and simply accept an estimate of today's value of ordinary mass energy $\mathbf{M_u}$ of the Hubble universe as given below, constructing therefrom an empty 2- sphere shell of radius $\mathbf{R}$ commensurate with the Hubble scale. More specifically, we imagine the entire mass $\mathbf{M_u}$ of the Hubble sphere spread uniformly over its surface area $\mathbf{4\pi R^2}$. From this "*toy model*" we derive two expressions for force, the first based upon the attraction between masses *a la* Newton's law-of-gravitation and the second founded upon recessional flow of expanding space.[7] To properly evaluate new interpretations of empirical facts, the reader is asked to suspend judgment based upon current theories constructed from models interpreting the present structure and state in terms of invariant factors (the so called constants of mass and gravity called into question in this study). In the light thereof, an alternative to the Standard Theory follows from a set of internally consistent equations derived primarily from Newtonian principles.

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[4]When asked to summarize General Relativity in one sentence Einstein Replied: *"Time, and space and gravitation have no separate existence from matter....physical objects are not in space, but these objects are spatially extended."*

[5] Newton's second law [**d/dt(mv)**] equates force to rate of change of momentum. It thus takes into account changes in both velocity and mass and therefore carries the implication of the now known fact that inertial mass is not invariant. Recessional velocities of nebula at large distances can be '**c**' or greater in standard theory, but these objects do not require relativistic correction inasmuch as they are co-moving with recessional space.

[6]In the nineteenth Century, certain notables such as, Ernst Mack, claimed the reactionary force exhibited by an isolated mass in empty space was the result of other matter scattered throughout the universe. Einstein was influence by this idea, and initially attempted to incorporate it into General Relativity, but later abandoned the Principle most likely because it appeared to require action at a distance. During the twentieth century, Fred Hoyle and others proposed cosmological models based upon continuous creation of matter (called steady state theories) which, after discovery of Cosmic Background Radiation, succumbed to theories based upon a hot dense beginning.

[7]The "Toy Model" gets its name from the idea of a fictional creation where different parameters can be played-with to simulate different histories with different results

Referring to **Figure 1**, the gravitational energy **U** of a two sphere is, by carrying matter in increments **dM** from the Hubble center to the Hubble surface:

$$\mathbf{U} = \int_0^{R}\int_0^{M_u} \mathbf{G(M_u - dM)(dM)(dR)} = -\frac{\mathbf{M_u{}^2G}}{\mathbf{2R}} \tag{1}$$

where, throughout this treatise, $\mathbf{M_u}$ refers to the positive mass energy of ordinary matter contained within a Hubble sphere of radius **R**. At the outset, we take ruminative notice of what appears to be a curious coincidence, specifically, the energy density of our two sphere construct is approximately one **kgm** per square meter. That is, for a Hubble radius in the range of **(1.3) x 10^{26} meters**, and estimated Hubble mass in the range of **1.5 x 10^{53} kgm**, the mass-energy of the 2-sphere universe can be approximated as:

$$\mathbf{M_u = 4\pi R^2\ kgm/meters^2} \tag{2}$$

or in terms of the surface density sigma,

$$\boldsymbol{\sigma} = \textbf{one kgm/meter}^2 \tag{3}$$

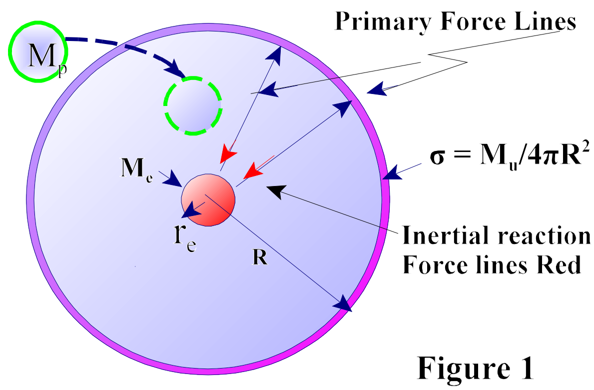

Figure 1

The 2-sphere is a make-believe **E**xpanding **R**ubber **S**heet **A**nalogy [**ERSA**] where imaginary experiments can be made and the results projected to the real world of three dimensional space. Equations (2) and (3) will prove particularly convenient for explanatory purposes. Expressing Hubble mass in terms of $\mathbf{4\pi R^2}\sigma$ will have surprising meaning. The 2-sphere simplifies imagery and dimensionality, and it leads its own set of internally consistent equations of an operative universe. Transformation from 2-sphere to 3-sphere follows from another of Feynman's observations "that it cost nothing to create a mass." The study of the net zero (energy) universe begins with a 2-sphere . **Figure 1**, the spherical co-centered mass $\mathbf{M_e}$ would be expected to experience the isotropic gravitational force field of the matter shell $\boldsymbol{\sigma}$, and correspondingly exert an equal attractive force upon the shell. But unless some dynamic endowment can be found, the toy universe of **Figure 1** will be gravity-less. The **G** factor necessary to couple $\mathbf{M_e}$ to the shell mass $\boldsymbol{\sigma}$ depends upon acceleration [**6.67 meters^3/sec^2/kgm** in **s.i**. units]. To create gravitational attraction between masses, space must be dynamically catalyzed. We are now ready to invoke volumetric acceleration via cosmological expansion.

$$\mathbf{a} = \mathbf{F/M_e = M_uG/R^2} \tag{4}$$

where "**a**" is the inertial reactionary force (per unit of mass $\mathbf{M_e}$) from Newton's second law and $\mathbf{M_u G/R^2}$ is the force (per unit of mass $\mathbf{M_e}$) from Newton's law of Gravity. From (2) and (3) there results:[8]

$$\mathbf{G = [a/4\pi\sigma]} \tag{5}$$

Net force within a uniform spherical matter shell is zero. In this simplified pictorial, the entire Hubble mass is symmetrically coupled to a single central test mass and consequently there will be no net directional force acting upon $\mathbf{M_e}$.[9] If another particle $\mathbf{M_p}$ is introduced between $\mathbf{M_e}$ and the Hubble matter manifold $\boldsymbol{\sigma}$, this new mass will be at the center of its own Hubble field and $\boldsymbol{\sigma}$ surface, the entire mass thereof coupling to $\mathbf{M_p}$. The reaction field of both $\mathbf{M_p}$ and $\mathbf{M_e}$ will be isotropic except to the extent modified by $\mathbf{M_e}$ and $\mathbf{M_p}$ acting upon one another.

If $\mathbf{M_p}$ is placed immediately beyond the $\boldsymbol{\sigma}$ shell, the same force prevails, but it is now unidirectional along a line of action between the centers of $\mathbf{M_p}$ and $\mathbf{M_u}$:

$$\mathbf{a = F/M_p = M_u G/R^2 = 4\pi G\sigma} \tag{6}$$

Newton's gravitational equation converts **3-D** global volumetric acceleration to local **g** fields. For an interior mass $\mathbf{M_e}$, the formula outputs these reactions as counter acceleration fields (illustrated by Red reactionary arrows) having strength magnitudes proportion to $\mathbf{M_e}$.

To find **G**, divide the recessional acceleration of space **'a'** by $\mathbf{4\pi\sigma}$ (equation 5). To find '**a**' the hubble sphere as used as a mensuration device, by definition the distance where spatial recessional flow equals the velocity of light "**c**." While there is no physical consequence to the size of the Hubble sphere, the scale **R** is a unique benchmark. Our interest is not in the velocity of the recessional flow '**c**' but the change in velocity at the limit of the Hubble sphere. Whence, we turn our inquiry to the question of whether recessional velocity is increasing or deceasing.

Using Newtonian notation, the volumetric growth of space $\mathbf{\dot{V}}$ <u>within the Hubble sphere</u> and its derivative $\mathbf{\ddot{V}}$ (volumetric acceleration) can be related to the spatial flux **dR/dt** and its rate of change $\mathbf{d^2R/dt^2}$. To find the internal production rate of space, we construct an imaginary Gaussian surface **S** of radius $\mathbf{R_S}$ to encompass the Hubble volume as shown in **Figure 2.** Accordingly, the following relations hold:

$$\begin{aligned}
\mathbf{V} &= \frac{\mathbf{4}}{\mathbf{3}}\pi\mathbf{R}^3 \\
\dot{\mathbf{V}} &= (\mathbf{4}\pi\mathbf{R}^2)(\dot{\mathbf{R}}) \\
\ddot{\mathbf{V}} &= \mathbf{8}\pi\mathbf{R}(\dot{\mathbf{R}})^2 + \mathbf{4}\pi\mathbf{R}^2(\ddot{\mathbf{R}})
\end{aligned} \tag{7}$$

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[8] The dimensional units of **G** are volumetric acceleration per unit mass. In the "**mks**" or "**si**" measurement system, this is expressed in cubic meters per second squared per kilogram $\mathbf{(m^3/sec^2)/kgm}$ where throughout this treatise, lower case "**m**" will refer to meters, capital "**M**" will refer to mass (either as inertia or energy) and "**kgm**" will refer to a kilogram of mass. Force will be denoted as newton's '**nts**' which is one **kgm meter per sec squared**. One kilogram of force (represented as '**kg**') equals 9.8 **ntn**

[9] A theory should be as simply as possible, but not simpler - Albert Einstein.

Figure 2

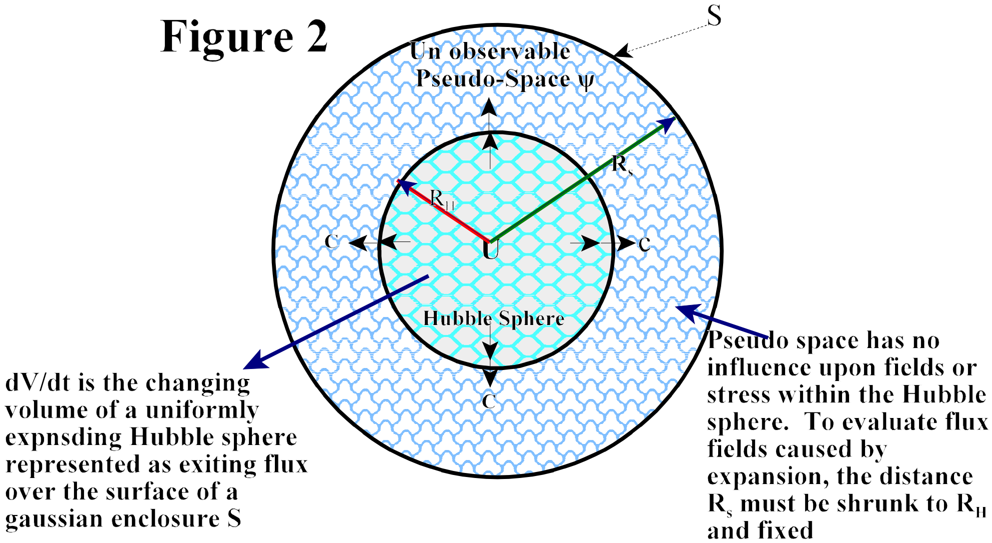

Figure 2. **<u>Spatial Expansion Modeled as Changing Volume.</u>**

The radius of the expanding Hubble sphere is given a subscript R_H to distinguish it from the fixed Gaussian sphere R_S. A Hubble sphere of radius R_H contains a volume $V_H = (4/3)\pi(R_H)^3$. For uniform radial dilation at velocity 'c' the volumetric acceleration of the Hubble sphere is $[8\pi(R_H)(c^2)]$. R_S represents the radius of a spherical Gaussian enclosure having a fixed surface area $4\pi(R_S)^2$, the rate of change of spatial volume dV/dt will equal $4\pi R_H{}^2c$ as indicated by the arrow dV/dt denoting spatial volume per second exiting across the fixed Gaussian surface. In a slowing universe, the Hubble dilates at greater velocity than recessional flow of internally expanding space; in an accelerating universe, the opposite is true. To evaluate the present state of the universe, it is necessary to know whether the acceleration is zero, positive or negative. When the radius of the Gaussian surface S is shrunk to $R_S = R_H$ (or conversely when the Hubble has expanded to R_S) the Gaussian surface takes a snapshot of the exiting flow as measured by the metering orifice area $4\pi R_s{}^2$. The conceptual significance of spatial flux exiting across the Gaussian surface is that it reveals the dynamic state of the universe within the Hubble sphere. All space beyond R_H can be ignored since only changes within the Hubble sphere contribute to acceleration. The changing radius of the expanding Hubble sphere is of no functional effect in determining the value of G. The instantaneous Hubble radius does tell us where to put the Gaussian gauge for measuring the internal rate of spatial growth in terms of the exit flux at the instant of coincidence.

Encompassing the Hubble sphere with a Gaussian surround '**S**' concurrent with the Hubble sphere at the instant of measurement is an adaptation of a volume to surface transformation first elaborated by the 18th century mathematician, Carl Gauss.[10] For purposes of determining the rate of volumetric acceleration, the Hubble universe is considered devoid of mass, composed only of infinitesimal volumes, each expanding uniformly in three dimensions. In this expose' volumetric expansion of space is treated as a functional operative, mathematically described in terms of a vector divergence field. The fractional change in volume per unit area can thus be regarded as a dynamic modulus, a measure of the intrinsic characteristic of expanding space. Gauss's divergence theorem relates the integral over the volume of the surface that contains the divergences to the flux exiting across the surface that contains the volume. To apply the theorem to find the acceleration of recessional space, integrate over the volume of the Hubble sphere and divide by the surface area. Thus for the Hubble sphere coincident with its Gaussian surround $\mathbf{R_H} = \mathbf{R_S} = \mathbf{R}$, then from (7):

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \frac{\mathbf{8\pi R(\dot{R})^2 + 4\pi R^2(\ddot{R})^2}}{\mathbf{4\pi R^2}} = \frac{\mathbf{2\dot{R}^2}}{\mathbf{R}} + \ddot{\mathbf{R}} \tag{8}$$

When (8) is expressed in terms of the deceleration parameter "**q**" then:[11]

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \frac{\mathbf{(\dot{R})^2}}{\mathbf{R}}[\mathbf{2 - q}], \qquad \mathbf{where...q} = -\frac{\mathbf{\ddot{R}R}}{\mathbf{\dot{R}^2}} \tag{9}$$

In an accelerating universe, $\mathbf{q = -1}$, and therefore:

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \mathbf{A_H} = \frac{\mathbf{3c^2}}{\mathbf{R}} = \mathbf{3H^2R} \tag{10}$$

For a universe determined by cosmological expansion, the object will be to connect the rate

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[10]**Johann Carl Friedrich Gauss** (1777 — 1855) sometimes referred to as the *Princeps mathematicorum* (The Prince of Mathematicians)..

[11]After the discovery of the velocity-distance law $\mathbf{v = Hr}$ circa 1928**,** and throughout most of the 20th century, expansion was assumed to be slowing due to gravity. To express the rate of change in terms of velocity and distance, a **q** factor was concocted with a minus sign and given the name "deceleration parameter." If the rate of expansion is increasing with time, then **dv/dt** is positive and equal to **H(dr/dt)** or what is the same, $\mathbf{H^2r}$. At the Hubble distance $\mathbf{r = R}$ and $\mathbf{v = c}$, so recessional flux exiting the Hubble sphere at any point is normal thereto. The Hubble surface is the transluminal locus of the $\mathbf{q = -1}$ universe where velocity is **c** and acceleration is ($\mathbf{c^2/R}$).

of growth to parameters that can be measured. Equation (10) expresses the volumetric acceleration per unit area of an exponentially expanding Hubble sphere in terms of the Hubble constant.[12] But equation (10) corresponds to Einstein's prescription for a static universe. More specifically, to balance the gravitational force $\mathbf{F_G}$ tending to collapse the universe:

$$\mathbf{F_G = GM_u/R^2 = 4\pi G\rho_u R/3}. \tag{11}$$

Einstein introduced a counter force $\mathbf{\Lambda}$ that, when multiplied by $\mathbf{R/3}$, would cancel gravity on the global scale. From the Friedmann-Lemaitre equations, this can be expressed as:

$$\mathbf{\Lambda R/3 = - 4\pi G\rho_u R/3 = -H^2R}$$

And therefore:

$$\mathbf{\Lambda = 3H^2} \tag{12}$$

The physical embodiment of Einstein's cosmological constant is de Sitter's exponentially expanding void. If the spatial content of the Hubble sphere were expanding at constant radial velocity $\mathbf{c}$, then $\mathbf{\ddot{R}}$ would be zero and volumetric acceleration (equation 10) would be reduced by1/3. During de Sitter expansion, volume accelerates at $\mathbf{\Lambda R}$ which is exactly what is required to create (**Big G**). Consistent with the velocity-distance law, the exponential growth of space is locked to the velocity '**c**' at distance **R** where recessional space becomes transluminal, that is, $\mathbf{c = HR}$ and $\mathbf{q = -1}$.

How is it, that $\mathbf{\Lambda}$, can at once fix Einstein's universe as static while sourcing exponential expansion. The metamorphosis from static to dynamic follows from the physical implementation of $\mathbf{\Lambda}$ as spatial expansion. For the mathematical model (General Relativity) to be static, the physiology must be functionally dynamic. For a uniform spherically symmetrical mass, the convenient Hubble center is the polar coordinate system concentric therewith. When Einstein's $\mathbf{\Lambda}$ is understood as spatial expansion, **G** emerges as the consequence.

In the light of later discoveries, Einstein's inclusion of $\mathbf{\Lambda}$ in the 1916-1917 edition of the

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[12]The same relationship follows if the $\mathbf{M_e}$ is placed immediately beyond the Hubble surface. $\mathbf{M_u}$ can now be considered a point mass separated from $\mathbf{M_e}$ by distance **R** per (6). The velocity-distance furnishes the acceleration, specifically if the rate of spatial expansion is increasing in proportion to the amount of space in existence, that is, since $\mathbf{v = Hr}$, then

$$\mathbf{dv/dt = H(dr/dt) = Hv = H^2r.}$$

At the Hubble sphere, $\mathbf{r = R}$, so the acceleration '**a**' is = $\mathbf{H^2/R}$. Equating this as the acceleration produced by the gravity field of the universe per(6) then:

$$\mathbf{M_uG/R^2 = H^2/R}$$

Substituting the cosmic density-volume product $\mathbf{\rho_u V}$ of the Hubble universe for $\mathbf{M_u}$, there results:

$$\mathbf{G = 3H^2/4\pi\rho_u}$$

This value is listed in the "Electronics World" table of constants. It obviously cannot be a constant because of the factor $\mathbf{\rho_u}$ in the denominator. Nor does it provide a physical model for **G** that can be used to rationalize the implied increase in **G** as the universe expands. [density is normally considered to diminish as $(1/R^3)$]. The derivation is not without merit however. When properly modified by a mass accretion algorithm, the above leads to the same value for **G** as the expanding two sphere model shown in **Figure 1**.

General Theory, proves to be of momentous significance. The relevance of the **Λ** as the source of **G** resolves many modern enigmas, including the puzzling question of why cosmic matter appears to be miraculously balanced between exponential expansion and gravitational collapse. Gravity is an emergent field, the consequence of inertial matter subjected to isotropic acceleration. The global **Λ** field creates the pseudo force coordinate system for local masses, in turn the inertial reaction thereof masquerades as the local "**g**" field emanating therefrom. The counter acceleration field, $\mathbf{M_eG}$ like all pseudo forces, is simply a Newtonian (2nd Law) reaction, that is (**Big G**) multiplied by a local mass gives little "**g**." It is of course necessary to resolve the **3-D** acceleration field of (**Big G**) to a directional line of action. As a mathematical equation, GR outputs correct results, but the physical model depends upon the reality of spatial curvature as a substitute for force (equation 10). In this treatise, it is not static space that is distorted, but rather the reactance field distorts the expansion dynamic by reducing the effective radius (See Equation 46 infra). The **G** force and the **Λ** source are harmonized, not because they are fine tuned, but because the former depends from the latter. If **Λ** were unidirectional, the **ma** force and the **mg** force would be identical, but opposite in direction. As it is, when the isotropic force's created by accelerating space is resolved along a particular line of action, it is equal to the **ma** force

It is now obvious why gravitational mass and inertial mass are equivalent, both forces are inertial reactions. Equation (10) is the isotropic volumetric acceleration per unit area at a point in free space. When resolved along one spatial dimension, the result is identical to that obtained from the velocity-distance law. To determine the field acting upon $\mathbf{M_e}$ in **Figure 1**, we impose the spatial acceleration field (10) upon the volume including the shell **σ**. From (5):

$$\mathbf{G_2 = c^2/4\pi R\sigma = (c^2/4\pi R)[meters^2/kgm]} \qquad (13)$$

The acceleration factor **Λ** acting upon the matter shell **σ** creates an isotropic inertial reaction field coextensive with the interior. Because the gravitational field of **σ** is symmetrical, no directional force acts upon the interior particles, (e.g., $\mathbf{M_e}$ and $\mathbf{M_p}$). The question arises as whether masses co-move with accelerating recessional flow. Acceleration of matter requires the expenditure of energy via forces doing work. This provokes as issue as to the necessity of the matter ring in the two sphere model. Since gravity is not distinguishable from inertial reaction, why the intermediate step of creating a reactive **G** field ? Moreover, if the matter shell is co-moving with the accelerating recessional flow of space, there is no reactionary force in any event. For the two sphere model, there appears to be no difference between spatial expansion acting directly upon the central mass $\mathbf{M_e}$ or indirectly via inertial reaction of the shell mass. However, matter and its distribution, is important in the three sphere model. For present purposes, we continue to exploit the **2-D** simplicity of the toy model, and calculate $\mathbf{G_2}$ from **R** based upon $\mathbf{H_o = c/R = 70}$.[13]

$$\mathbf{R = (3x10^8\ m/sec)/(2.3 \times 10^{-18}\ sec^{-1}) = 1.3 \times 10^{26}\ meters} \qquad (14)$$

From equation (13), the value of $\mathbf{G_2}$ (the gravitational constant for a two sphere universe) is:

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[13]The present value of the Hubble constant $\mathbf{H_o}$ is usually expressed as the recessional rate in (**km/sec**) per unit of distance measured in mega parsecs (**mpc**). One $\mathbf{mpc = 3.09 \times 10^{19}km}$. Thus for a Hubble constant $\mathbf{H_o = 70}$, (or $\mathbf{2.3 \times 10^{-18}/sec}$) the Hubble time $\mathbf{1/H_o}$ is = **3.09/70** or $\mathbf{4.4 \times 10^{17}\ sec.}$ One year equals $\mathbf{3.16\ x10^7\ sec}$, so the approximate age of the universe is **14 Gy.** The measured value of **G** ($\mathbf{6.67 \times 10^{-11}\ m^3/sec^2}$ **per kgm**) corresponds to a Hubble constant in the range of **70 km/sec/mpc**).

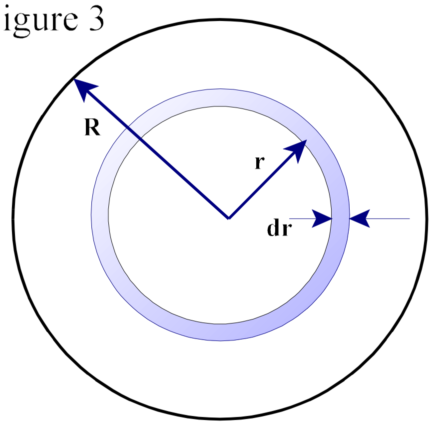
$$\mathbf{G_2 = [(3\ x10^8\ m/sec]^2/4\pi(1.3\ x\ 10^{26}\ m)\sigma = 5.5\ x\ 10^{-11}\ m^3/sec^2\ kgm^{-1}} \qquad (15)$$

The gravitational factor $\mathbf{G_2}$ reflects the energy difference between the two sphere model with all mass uniformly spread of the Hubble sphere and the fully homogenized three dimensional universe of the real world. More particularly, the gravitational energy required to build a uniform density three sphere from thin spherical shells of thickness **dr** is illustrated in **Figure 3**. The differential work at each stage of assembly is

$$\mathbf{dU = GM_r(dM)/r}$$

And since $\mathbf{M_r = \rho_u(4/3)\pi r^3}$, then $\mathbf{dM = \rho_u(4\pi r^2(dr)}$, the total work in building the universe is:

Figure 3



$$\mathbf{U = G\int_0^R \frac{16}{3}\pi^2(\rho_u)^2 r^4 dr = \frac{3G(M_u)^2}{5R}} \qquad (16A)$$

From equation 1, the ratio of the gravitational energy between a two sphere and a three sphere, each having the same mass $\mathbf{M_u}$ and the same radius **R**, is:

$$\frac{U_3}{U_2} = \frac{\dfrac{\mathbf{3(M_u)^2 G_3}}{\mathbf{5R}}}{\dfrac{\mathbf{(M_u)^2 G_2}}{\mathbf{2R}}} = \frac{6}{5} \qquad (16B)$$

In other words, if the radii and masses are the same in both expressions, the larger gravitational energy $\mathbf{U_3}$ of the three dimensional universe can only be the result of $\mathbf{G_3}$ greater than $\mathbf{G_2}$ by a factor **6/5**. From (15) a present value for the real world **G** is:

$$\mathbf{G_3 = (6/5)G_2 = (6/5)\ (5.5\ x\ 10^{-11}\ m^3/sec^2\ kgm^{-1}\ )}$$

$$\mathbf{= 3c^2/10\pi R = 6.6\ x\ 10^{-11}\ (m^3/sec^2)\ kgm^{-1}} \qquad (17)$$

We see that in both the **2-D** and **3-D** models, **G** is inversely dependent upon cosmic radius. Experiments to measure changes in **G** based upon long term observations of planetary lunar orbits have shown them to be extremely stable. This would seem to place tight constraints upon the constancy of **G**. But the stability of orbits depends upon the **MG** product. Specifically, orbital parameters **r** and **v** are found by setting the central **GM** force equal to centripetal force, i.e.,

$$\mathbf{F = GMM^*/R^2 = M^*v^2/r} \text{ and therefore } \mathbf{GM = rv^2} \qquad (18)$$

In the standard model, **R** and **H** are expected to change as the universe ages. Variable **G** theories are suspect because the many attempts to measure long term changes in planetary Lunar orbits have proved unsuccessful. But these experiments only confirm the invariance of the **MG** product, they do not measure **M** or **G** as separate factors. The essence of inertial matter is tied to its global gravitational field; the energy in the reactance field depends upon the volume of the expansion field. While **G** has long been suspected as a variable, gradually acquired inertia as the compliment of diminishing **G** will be difficult for most readers to accept.[14]

The idea of mass as, substantive, durable and conserved is mis-perception.[15] **G** has units of volumetric acceleration per unit mass [$\mathbf{m^3/sec^2}$ **per kgm**]. To what might those units apply other than expanding space? And if they apply to expanding space, is it not conceivable that the rate of expansion would vary as volume changed? The stability of orbits is testament to the invariance of the **MG** product. If **G** does diminish as **1/R**, **M** must increase in proportion to **R**. And if individual masses accrete inertia in proportion to **R**, the total cosmic mass must increase in proportion to $\mathbf{R^2}$.

Friedmann and Lemaitre set a difficult course for later cosmologists by tacitly embracing $\mathbf{M_u}$ as an initial condition precedent to the genesis of dynamic expansion. Later theorists adhered to the same sermon, even going so far as to propose a variety of inflationary theories that stoked the universe, in less than a jiffy, with a precise compliment of matter $\mathbf{M_u}$ that delicately balanced the initial kinetic energy of expansion. This was good for cosmologists, they had much to explain during the 20th century as to why the universe is fine tuned. If $\mathbf{M_u}$ and **G** are fixed, how is energy accounted for during expansion. Energy must be added to increase the cosmic radius against the gravitational force tending to contract all matter to a point. But in both the two sphere and three sphere formalisms, gravitational field energy **U** diminishes as **1/R** during expansion.

Prior to GR, gravitational mass ($\mathbf{M_G}$) was viewed as a separate but enigmatically equal functionality of inertial mass ($\mathbf{M_I}$). In unifying the two masses as one-in-the-same *a la Equivalence,* Einstein founded a new physical law—the facility of inert matter to curve static space. In its stead, here introduced, an interpretation of the '**g**' field as dynamically induced distortion—not of space *per se*, but the symmetry of the global expansion field. Emergent '**g**' fields are the manifests of non-expandable masses subjected to isotropic spatial acceleration—they have no separate existence from matter or the global source (**Λ**) which brings about their means.[16] They are analogous to pseudo forces, and within Feynman's characterization of inertial reaction, properly called pseudo fields.

If mass is not an up-front requirement for a viable expansion algorithm, when does it debut? In 1951, cosmologist William McCrea theorized a mass creating process founded upon expanding negative pressure. In a uniformly expanding void, tension or pressure should be everywhere the same, observers if there were any, would have no awareness of the field. McCrea argued, however, that if matter were sprinkled throughout the volume, a negative pressure void would behave quite differently from a positive pressure space where Pascal's law applies (pressure equalized throughout

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[14] In 1937 Paul Dirac published the Large Number Hypothesis (**LNH**). Reasoning that the near equality between the electro/gravitational force ratio and Hubble/subatomic size ratio must be more than a coincidence, Dirac suggested that these large numbers maintain the same proportions at all times. This can only be true if one of the so called constants of nature changed as the universe expands. This lead to Dirac's hypothesis that **G** varies as $\propto$ **(1/R)**.

[15] There is no law of conservation of mass, indeed, the inertial resistance of masses to acceleration increases for masses traveling at high velocities relative to the fame of measurement. Nor is their bases for the idea of a mass genesis, although much effort has been directed to justifying instant and/or nearly instant mass creating algorithms.

[16] From Einstein's abbreviated statement of General Relativity (footnote 4).

the volume). Negative pressure was prophesied to be the result of tension, so it was reasoned that non-expanding masses would create local areas of resistence to expansion, i.e., gradients. Together with Edward Milne, the theory was reduced to a problem of dynamics, more specifically Milne and McCrea were able to derive Einstein's two gravitational equations (19) and (20) from Newtonian principles[17]

$$\ddot{\mathbf{R}} = -\frac{4\pi\mathbf{G}}{3}\left[\rho_{\mathbf{u}} + \frac{3\mathbf{P}_{\mathbf{s}}}{\mathbf{c}^2}\right]\mathbf{R} + \frac{\Lambda\mathbf{R}}{3} \tag{19}$$

$$\left[\frac{1}{R}\frac{dR}{dt}\right]^2 = \frac{8\pi\mathbf{G}\mathbf{R}^2\rho_{\mathbf{u}}}{3} + \frac{\Lambda\mathbf{R}^2}{3} - \frac{kc^2}{R^2} \tag{20}$$

where $\mathbf{k/R^2}$ is the curvature. In a universe where tension equals energy density, the equation of state is:

$$\mathbf{P = -\rho_u c^2} \tag{21}$$

and (19 and (20) become:

$$\mathbf{\Lambda = -8\pi G\rho_u - 3qH^2} \tag{22}$$

$$\mathbf{k/R^2 = -H^2(q+1)} \tag{23}$$

The condition $\mathbf{P = -\rho_u c^2}$ corresponds to the balanced state that exists when the positive energy released by expansion maintains density constant. This is McCrea's ingenious idea for the creation of matter.[18] It provided a foundational bases for a *constant density universe*. By assuming $\mathbf{q = -1}$ and $\mathbf{\Lambda = 0}$, Fred Hoyle seized upon the concept as the foundational mechanism for a *Steady State Universe* wherein $\mathbf{8\pi G\rho_u = 3H^2}$. In 1981, Alan Guth appropriated McCrea's recipe to develop his own mass creating algorithm, introduced by the name: "*Inflation*."[19] Here we investigate an alternative state, also admitted by (19), namely the "*constant pressure universe*." When negative pressure $\mathbf{(-P) = \rho_u c^2/3}$ then (19) reduces to:

$$\ddot{\mathbf{R}} = \frac{\Lambda\mathbf{R}}{3} \tag{24}$$

Equation (24) has the same solution as de Sitter's empty universe, that is, when the pressure of expanding space is negative and cancels positive energy density, the universe behaves as though it were empty:

$$\mathbf{(\rho_u c^2/3) = (-P)} \tag{25}$$

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[17]Equations (19) and (20) were originally synthesized from General Relativity by mathematical skill and labor. That entirely different approaches to gravity should lead to the same equations is still somewhat of a mystery.

[18].McCrea's concept exists in one form or another in most creation theories. In contrast to Hoyle's "*Steady State Theory*," the doctrine of gradually acquired inertia foretold herein, requires no new particle production.

[19]Like instant genesis, the supposition of rapid exponential grown during inflation results in a whole lot of up-front energy produced in a short span of time.

Pressure **P** = (acceleration)x(surface density). For a 2-sphere shell density sigma equal to (**one kgm/meter^2**), then $\mathbf{a\sigma}$ is:

$$\mathbf{P = -(c^2/R)\sigma = \rho_u c^2/3} \tag{26}$$

And therefore
$$\mathbf{\rho_u = 3\sigma/R} \tag{27}$$

And since
$$\mathbf{\rho_u = M_u/(4/3\pi R^3) = 3\sigma/R} \tag{28}$$

Then
$$\mathbf{M_u = 4\pi R^2\sigma} \tag{29}$$

Comparison with (2) and (3), suggests the possibility that cosmic mass per unit of Hubble surface area could be a constant. If true for the two sphere, then perhaps it is also true for the 3-sphere. If so, then a long standing cosmological puzzle is unraveled. Is there some deep and profound significance to the ratio?

$$\frac{\mathbf{M_u G}}{\mathbf{c^2 R}} = \mathbf{1} \tag{30}$$

Why should $\mathbf{M_u c^2/Rc^2}$ equal "**1**" within the limits of experimental error.[20] From (13) and (29), we see that for the 2-sphere, (30) is an identity equation true for any radius at any time:

$$\frac{\mathbf{M_u G}}{\mathbf{c^2 R}} = \mathbf{1} \quad = \quad \frac{\mathbf{(4\pi R^2)(c^2)\sigma}}{\mathbf{(c^2 R)(4\pi R)\sigma}} = \mathbf{1} \tag{31}$$

However, the situation is a bit more complex for the 3-sphere. If the factors energies are subscripted as follows:

$$\mathbf{U_2} = \frac{\mathbf{(M_{U2})^2 G_2}}{\mathbf{2R_2}}. \quad \textbf{and} \quad \mathbf{U_3} = \frac{\mathbf{3(M_{U3})^2 G_3}}{\mathbf{5R_3}} \tag{32}$$

Total net energy for either a 2-sphere or 3-sphere universe equals zero. That is,

$$\mathbf{E_2 - U_2 = 0} \quad \text{and} \quad \mathbf{E_3 - U_3 = 0} \tag{33}$$

Starting from the 2-sphere shell model with gravitational energy $\mathbf{U_2}$ specified by (32), we carry out

[20] Robert Dicke of Princeton searched long and hard for a scalar-tensor theory of gravity based upon the proposition that the numerator and denominator of (30) represented the connection between inertial and gravitational mass via Mach's Principle. To make merit of Dicke's theory, $\mathbf{Rc^2/G}$ must equal $\mathbf{M_u}$. The problem has been to find a way in which $\mathbf{Rc^2}$ determines the value of **G**. That issue is resolved as equation (13) for the 2-sphere universe. If cosmic mass always equals $\mathbf{4\pi R^2}$ whatever the value of **R**, it is only necessary to decrease the 2-sphere **R** by a factor of **5/6** to make (31) applicable to a 3-sphere universe. The 2-sphere formulation of $\mathbf{G = c^2/4\pi R}$ with **R** reduced by **5/6** reduces the operative value of **R** in (31) to $\mathbf{1.1 \times 10^{26}}$ meters. A more useful approach, however, is to consider **R** invariant when making the transposition from 2-sphere to 3-sphere topology.

a thought experiment (what Einstein referred to as a Gendanken) by first distributing $\mathbf{M_{U2}}$ uniformly throughout the Hubble volume. No change is made in the amount of mass $\mathbf{M_{U2}}$ or the scale $\mathbf{R_2}$, we take note of the fact gravitational energy has increased by a factor of **6/5**. Since the only factor not imported from the two sphere model is $\mathbf{G_2}$, we conclude that the redistribution of $\mathbf{M_{U2}}$ from a surface density $\boldsymbol{\sigma}$ to a volume density $\boldsymbol{\rho}$ causes an increase in gravitational energy and consequently the value of **G** must have increased by a factor of **6/5**.

$$\mathbf{U_{2-3} = \frac{3(M_{U2}\ )^2[6/5]G_2}{5R} = \frac{3\left(M_{U3}\right)^2 G_3}{5R}} \tag{34}$$

In this first phase of our thought experiment, the increase in gravitational energy is tied to the distribution of matter. $\mathbf{U_3}$ is greater than the original energy $\mathbf{U_2}$ but no additional matter has been added. In a zero energy universe, negative gravitational energy must equal positive matter energy, so by holding **R** and $\mathbf{M_u}$ constant (i.e., $\mathbf{R_2} = \mathbf{R_3}$ and $\mathbf{M_{U2}} = \mathbf{M_{U3}}$), then **G** gets the upgrade.

To complete our Gendanken design of the real Hubble sphere, we pose the question as to how much positive matter energy is needed to construct a 3-sphere with gravitational constant $\mathbf{6/5G_2}$ having the same energy $\mathbf{U_2}$ of our original 2-sphere? Or rephrased, to construct a three sphere Hubble universe from scratch with the correct **G** and **R**, how much matter is required if it is to have a gravitational energy $\mathbf{U_4}$ equal to our original two sphere energy $\mathbf{U_2}$?

$$\mathbf{\frac{3\left(M_{U4}\right)^2 G_3}{5R} = U_2 = \frac{\left(M_{U2}\right)^2 G_2}{2R}} \tag{35}$$

This equation can be satisfied if $\mathbf{M_{U4}}$ is $\mathbf{5/6\ M_{U3}}$, in which case:

$$\mathbf{U_{4-3} = \frac{3}{5R}\left[\frac{5}{6}M_{U3}\right]^2 \frac{3c^2}{10pR} = \left[\frac{M_{U2}c^2}{2}\right]} \tag{36}$$

Accordingly, the ratio $\mathbf{M_uG/Rc^2}$ for the 3-sphere is:

$$\mathbf{\frac{\left(\frac{5}{6}\right)M_{\mathit{U2}}\left(\frac{6}{5}\right)\left(\frac{c^2}{4\pi R}\right)}{c^2R} = 1} \tag{37}$$

which is the same as identity equation as (30). $\mathbf{\sqrt{M_uG/R}}$ thus restates **c** as a universal constant, the connective between space and time.

Real time experiments cannot measure separate changes in **G** or **M**, nor can these experiments distinguish between changes in one with respect to the other. In our thought experiment, transformation from 2-sphere to 3-sphere enhanced **G** by **6/5**, provided $\mathbf{M_U}$ and **R** remain constant. This increase in energy $\mathbf{U_3}$ over $\mathbf{U_2}$ can be rationalized as added tension stress in form, increased negative pressure. Every mass creates its own counter reaction **g** field coextensive with the Hubble

volume.[21] The interaction of **g** fields manifests as attraction between masses, the isotropic stress field of empty expanding space being augmented by the reaction from the average global density $\boldsymbol{\rho_u}$. The collective affect of distributed matter is thus automatically taken into account, i.e., the **G** stress is a synthesis of empty spatial expansion plus intra-matter interaction. **G** is thus more than empty expanding space; in this sense $\boldsymbol{\Lambda}$ and **G** since are not identical. While expansion of empty space interacting with matter creates local **g** fields, the measured value of **G** depends upon the totality of that interaction. **G** is gravitational stress, by its dimensional units "*volumetric-acceleration-per-unit-mass*." The interaction of expanding space with uniformly distributed "expansion-resistant-matter" is the global stress field.[22]

As previously emphasized, the invariance of the **MG** product is well established by orbital stabilities. To discriminate between the present values of **G** and **M** and those of an earlier era, some long past phenomenological event must leave a presently observable residue evidencing probative change (noticeably different from what would be expected using today's values). Orbits are stable because centripetal mass cancels gravitational mass; only the central mass is left to balance **G** in the orbital condition $\mathbf{v^2r = MG}$. By contrast, a past gravitational event which depends upon two masses ($\mathbf{M_1M_2G/R^2}$) would be expected to produce less force in the past since there is one **G** factor (that diminishes as $\mathbf{1/R}$) and two mass elements ($\mathbf{M_1}$ and $\mathbf{M_2}$ both prophesied herein to augment $\propto \mathbf{R}$). To confirm a theory is impossible, to falsify a theory, only one ugly fact is required. We take notice of the following two observational anomalies discussed in the appended pages below:

1) The Faint Sun Syndrom (Search Google for Description)

2) The Faint Supernova Studies (See Appendix I Infra)

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[21] An estimate for the Hubble mass $\mathbf{M_{U3}}$ based upon a Hubble radius $\mathbf{R = 1.3 \times 10^{26}}$ meters is therefore:

$$\mathbf{M_{U3} = (5/6)(4\pi R^2) = 1.77 \times 10^{53}\ kgm}$$

And from (30), the corresponding value of $\mathbf{c^2}$ would be:

$$\mathbf{c^2 = M_{U3}G_3/R = 9 \times 10^{16}\ meters^2/second^2}$$

[22] As suspected by Robert Dicke, the ratio is not a coincidence nor is it a peculiar condition of the present size of the universe. As noted in connection with (17), we initially considered the energy difference between the two sphere and three sphere models as an augmentation of **G**. To make the transition from the 2-sphere toy model to the real world 3-sphere, the **G** value from (13) must be replaced by the **G** value from (17). If the numerator of (30) is to equal the denominator, then the cosmic mass $\mathbf{M_u}$ must also be adjusted to reflect the fact that for the same size 2-sphere and 3-sphere universe, the mass factor must be appropriately reduced if the energies are to be the same. Accordingly, with

$$\mathbf{G_3 = 3c^2/10\pi R\sigma}$$

and

$$\mathbf{M_{U3} = (5/6)(4\pi R^2)\sigma}$$

SUMMARY ABSTRACT WITH ADDITIONAL OBSERVATIONS

The dimensional units of **G** can be interpreted either as volumetric acceleration per unit mass or directional acceleration "**a**" per unit of surface density sigma. For a Hubble mass $\mathbf{M_u}$ in the range of $\mathbf{5 \times 10^{43}}$ **kgm** and a Hubble radius **R** in the range of $\mathbf{1.3 \times 10^{26}}$ meters (corresponding to $\mathbf{H_o = 70}$), **σ** can be approximated as **one kgm per square meter**. This envisions a simple 2-sphere toy model construct with the mass $\mathbf{M_u}$ spread uniformly over the Hubble manifold of area $\mathbf{4\pi R^2}$. Per Newton's 2[nd] law, the isotropic force acting upon a Hubble concentric uniform spherical mass $\mathbf{M_e}$ of radius "$\mathbf{r_e}$" is:

$$\mathbf{F/\sigma = M_e(a/\sigma)} \tag{38}$$

From the velocity distance law and the presumption recessional spatial flux is correctly interpreted as real velocity change, we arrive at the exponential concordance model (as might be expected for any naturally occurring growth processes where the temporal rate of change of a factor is proportional to the factor. [$\mathbf{(dV)/dt] = kV}$]. This is the de Sitter formalism $\mathbf{q = -1}$ which corresponds to spatial recessional acceleration $\mathbf{a = c^2/R}$ at the Hubble surface. The gravitational force per unit mass at the Hubble surface is therefore $\mathbf{(c^2/R)/\sigma}$.[23] The affect of this field acting upon the central mass is the reactionary field illustrated by the Red Inertial Reactionary Lines shown in **Figure 1 (**The isotropic spatial expansion flux is countered by the non-expand ability of $\mathbf{M_e}$ resulting in the inwardly directed field '**g**' field of $\mathbf{M_e}$). In one of natures greatest charades, the reactionary acceleration field '**g**' appears to originate within $\mathbf{M_e}$ and emanate therefrom. In reality, the '**g**' counter field is simply a local distortion of the source. The masquerade is further enhanced by the fact that the counter field falls off inversely with the square of the distance. This, however, should be expected because the reaction must be isotropic to counteract the isotropic source, and since the isotropic reaction field is centered upon $\mathbf{M_e}$, the intensity of the isotropic reactionary acceleration diminishes inversely with area (the same number of reactionary force lines cross each imaginary shell surrounding $\mathbf{M_e}$, so reactionary field intensity diminishes as $\mathbf{1/4\pi r^2}$, ergo for any distance **r** greater than $\mathbf{r_e}$, the reactionary force created by inertia $\mathbf{M_e}$ is:

$$\mathbf{F = [M_e(c^2/R)/\sigma][1/4\pi r^2]} \tag{39}$$

This is the **g** field of $\mathbf{M_e}$ acting against the primary field. Relative acceleration between recessional space and $\mathbf{M_u}$ (geometrically synthesized as the density shell **σ**) creates the primary field which in turn acts upon $\mathbf{M_e}$ to create the inertial counter reaction **g** field of $\mathbf{M_e}$ (In the case of the 2-sphere, it makes no difference if the mass $\mathbf{M_e}$ is subjected directly to the volumetric acceleration field of expanding space or the reactionary field **σ)**. While that is not the case for the 3-sphere reality model, there are yet to be explored conceptual aspects of the 2-sphere toy model. Specifically, by rewriting (39) as:

$$\mathbf{F = F_g = G_2[(M_e)/r^2]} \tag{40}$$

$\mathbf{F_g}$ for a two sphere is simply Newton's 2[nd] law adapted to express inertial reaction in response to global expansion, where: $\mathbf{c^2/4\pi R\sigma}$ is replaced by the symbol $\mathbf{G_2}$. (41)

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[23]The velocity of the shell is of no significance, it can co-moves with the Hubble sphere at velocity **c**, but in order to provoke an inertial counter field, the mass cannot be accelerating at the same rate as space. Moreover, since gravitational retarding force is equal to the cosmological acceleration force, theforce of accelerating spatial recession is nullified. Where space not accelerating, the mass of the Hubble sphere would cause gravitational collapse.

Before moving on, we take advantage of the 2-sphere toy universe for a conceptual check on the relationship between the **G** source field and the **g** reactive field for a well known object. Using the earth's mass for $\mathbf{M_e}$ and the earths radius $\mathbf{r_e}$, then from **Figure 1** we have $\boldsymbol{\sigma} = \mathbf{1}$ **kgm/m**^{2}. To find the earths subordinate '**g**' field from the reaction of its local mass to the $\boldsymbol{\sigma}$ surface density reaction, we form the surface density ratios, specifically, for a spherical planet **P** of radius $\mathbf{r_e}$ having a mass $\mathbf{M_e}$ distributed uniformly over its surface area, the surface density $\boldsymbol{\sigma_e} = \mathbf{M_e/4\pi(r_e^2)}$. For the Hubble sphere per, the surface density is one **kgm/m**^{2}. In **Figure 4**, **R** is the Hubble radius (blue circle) for the earth The normal component of cosmological acceleration for an exponentially expanding Hubble sphere is $\mathbf{A_n = c^2/R}$, accordingly:

$$\frac{\mathbf{g}}{\mathbf{A_n}} = \frac{\sigma_{\mathbf{e}}}{\sigma_{\mathbf{u}}} = \frac{\dfrac{\mathbf{M_e}}{4\pi(\mathbf{r_e})^2}}{\dfrac{\mathbf{M_u}}{4\pi(\mathbf{r_e})^2}} = \frac{\dfrac{\mathbf{M_e}}{4\pi(\mathbf{r_e})^2}}{\dfrac{\mathbf{kgm}}{\mathbf{meters}^2}}$$

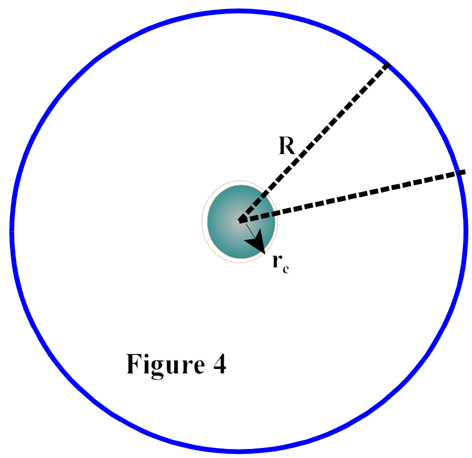

Figure 4

From which the acceleration field for the earth will have a surface value **g**:

$$\mathbf{g = [M_e/4\pi(r_{e)}{}^2](c^2/R)(meters^2/kgm)}$$

For earth $\mathbf{M_e = 5.98 \times 10^{24}}$ **kgm** and $\mathbf{r_e = 6.37 \times 10^6}$ **meters**, so $\mathbf{g_e}$ is **8.16 m/sec**^{2} for the two sphere model with $\mathbf{R = 1.29 \times 10^{26}}$ meters. When **G** is increased by **6/5** to compensate for the 2-sphere/3-sphere energy difference, $\mathbf{g_e = 9.8}$ **m/sec**^{2}.

In a Mercator projection, like that shown in **Figure 5**, the Hubble area and the planet earth are each represented by flat surfaces as shown in **5.** As the Hubble sphere recedes, the false vacuum expands creating positive energy. The change in energy per unit of spatial volume **dE/dS** equals force. The resulting **g** is as given above, the **5/6** adjustment factor being again required to account for the difference in size between a two sphere and three sphere universe having equal energy.

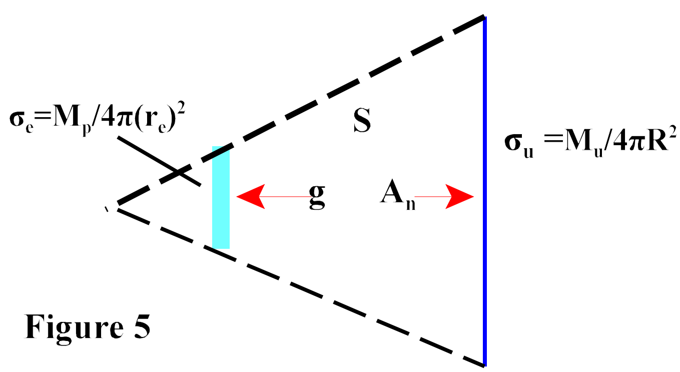

Figure 5

Appendices

I. THE FAINT SUPERNOVA STUDIES - THE ACCELERATING UNIVERSE

Spontaneous creation has been a recurrent theme throughout scientific history. While an abrupt beginning of spatial expansion is plausible, it need not include the entire mass of the universe in a single event just as it does not include all of space. The sudden appearance of mass-energy out of nothing is discrepant with all that is known about evolutionary process..... like Zeus springing full grown from the head of Athena. Nonetheless, the general sentient of the twentieth Century had the more distant galaxies receiving a greater initial boost and therefore traveling farther since the beginning. The model was fortified by the belief recessional velocities were slowed by gravity, and for mainstream cosmology, exponential deceleration was the defacto standard for many years. The all at once matter myth requires expansion velocity to be fine tuned to avoid a quick crash or runaway.

The constant radial rate universe (**$q = 0$**) fulfils the requirement for a well behaved expansion algorithm. Based upon the unity of "space and time," the three spatial dimensions increase by **3×10^8 meters** each second, and consequently volume increases geometrically. Space is created at the same rate as the Hubble volume, and **G** is variable. The intensity of negative pressure during the first few jiffies of expansion account for the hot dense particle creation era from which all forms of matter succeed. No special dispensation is needed by way of an inflationary interlude, in fact inertial mass is continuously enhanced by the same mechanism first proposed by William McCrea and later by Allen Guth with others. The (**$q = 0$**) universe embraces a form of acceleration (volumetric) as a long term proposition. But there is more to the story.

In 1998 a group of astrophysics, Saul Perlmutter, Brian Schmidt and Adam Riess, undertook to investigate type **1a** supernova data to determine how fast the universe was slowing. The study was based upon the proposition that SN bursts could be used as standard candles–the exclamation of identical energies, and therefore of equal brightness and duration. To their surprise, the intensity of the more distant events were fainter than expected; the universe appeared to be accelerating.

The gravitational pressure needed to trigger a supernova was derived in 1932 by the Indian physicist, Subrahmanyan Chandrasekhar, for which he later received the Nobel prize.[24] The critical energy **M_{limit}** (approximately 1.4 solar masses) depends upon the factor **($hc/4\pi G$)**. If **G** diminished inversely with **R**, the invariance of the **MG** product speaks directly to the question of whether supernova events were less energetic in the past. If that be so, the evidence for exponential expansion vanishes, and so also does the search for dark matter.[25] The irony is that the acceleration factor seems

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[24] A white dwarf star is kept stable by two opposing forces: 1) the electron degeneracy pressure created by nuclear fusion in the heart of the star (making lighter elements into heavier ones) pushing outwards from the core, and 2) gravity pulling inwards. When a white dwarf is locked in an orbit with a companion star, it sucks off matter over time. This increases the gravitational pressure until it overcomes the electron degeneracy pressure. The amount of mass in the core has a special significance called the Chandrasekhar Limit. When the core acquires a mass of approximately 1.4 solar masses, the electron degeneracy pressure is overcome by the pressure of gravity acting upon the core.

[25] As a side note, efforts to explain the present value of **G** in terms of **$q = ½$** led to much frustration for the author. The discovery of Cosmological Acceleration provided a good fit to the empirical value of **G** based upon standard model consensus **$H_o = 71$**. The perception of uniformly expanding **3-D** space as 'time' can be appreciated as a consequence of a changing **4th** dimensionality.

to be required in order to derive the correct value of **G**. In other words, exponential cosmological expansion is the auspicate of the declining **G** theory, and its corollary, the doctrine of acquired inertia.

But even if space is accelerating across the Hubble boundary, there is an issue as to the acceleration of luminous objects (the nebula). If the galaxies are co-moving wrt spatial recessional flow, all is well with the interpretation of the universe as accelerating expansion ($\mathbf{c^2/R}$ at the Hubble sphere). But for space to accelerate matter requires energy - something in the form of dark energy is needed, and its operative means explained within the context of a zero energy universe. From the perspective of the Hubble center, the entire mass of the Hubble sphere is in the retardation field of a mass $\mathbf{M_p}$ at the Hubble limit. For a quick calculation using the two sphere analogy, the retarding force per unit of mass is:

$$\mathbf{F/M_p = M_uG/R^2 = (4\pi R^2\sigma)(c2/4\pi R)(1/R^2 = c^2/R} \tag{44}$$

The retarding force exactly balances the acceleration force produced by exponential spatial expansion. We must thus consider the possibility that matter is not accelerating - neither now, nor in the past. Space is accelerating, indeed spatial acceleration is essential to correctly explain the magnitude of **G**. (In the above, we also arrive at the same result if we use the 3-sphere model of the universe).

In a coasting-matter universe, expansion of space produces accelerating volumetric growth. No mysterious *Dark Energy* is required to explain the observational data.[26] A larger **G** factor in the past requires less mass to create the same force. Since electron degeneracy pressure is constant, less mass is required to trigger a **1a** supernova event in the early universe. If intensity diminution is the result of less mass rather than greater distance, the theory of the accelerating universe is in trouble.

[26]Because the **MG** product is constant, the weight of the mass required to overcome the degeneracy pressure is the same at all eras. When the weight overcomes the electron degeneracy pressure, the white dwarf star collapses with a violent luminous display. Since the electron degeneracy pressure does not change with time, the **MG** pressure required to trigger a supernova event will also be invariant irrespective of the individual contributions of **G** and **M.** A robust **G** during an earlier era translates to smaller **M**, and consequently less energetic events. For the present value of **G**, Chandrasekhar's equation predicts 1.4 solar mass as the critical value.

Conclusions:

The evolution of the universe will be guided by exponential expansion when negative pressure **($-P = \rho_u c^2/3$)**. By all accounts this would appear to be an initial condition requirement of a zero energy universe. But it can also be a later life cosmic event that arises when an initially large negative pressure is overtaken by positive matter density. If so, account must be taken of the manner in which energy is balanced prior to the onset of the transition condition. Negative pressure diminishes inversely with **R** per (26), and in Standard Theory density falls off as **$1/R^3$**. Exponential expansion follows when **($-P = \rho_u c^2/3$)**, but this raises issues as to the cosmic state prior thereto and the origin of the initial energy. These interesting questions are the subject of much speculation, the theme here, however, is to correlate the *'present'* **G** force with the '*now'* rate of cosmological expansion. To that end, we have pursued a line of interrogation originating with an intrinsic property of the void, namely, volumetric acceleration per unit area **$3c^2/R$** [exponentially expanding space defined by the present radius **R** of the Hubble sphere]. From Newtonian dynamics, **"G"** follows from Einstein's cosmological constant **$\Lambda = 3H^2$**. Local "**g**" fields are the inertial reactance of individual masses to the isotropic acceleration of the **G** field. In this sense, every uniform spherical mass can be considered concentric with its own polar coordinate system; local "**g**" fields are pseudo forces, the reaction of non-expanding matter subjected to the global acceleration field.

The implications of the General Theory are bound up in Tensor equations that obscure the physical meaning. In his brief treatise of the General Theory in this Physics Lecture series, Richard Feynman adopted a simply analogy to illustrate the physiology of spatial distortion. The idea involved a spherical spatial surface encompassing a concentric spherical mass **M**. The Swartzchild solution for a uniform Mass **M** appears as a defect in the measured area **A** of the encompassing surface. The actual radius **r_m** of this surface will exceed the radius calculated from Euclidean geometry by an amount proportional to **M**. The excess radius **δr** for a static space is:

$$\delta r = r_m - (A/4\pi)^{1/2} = MG/3c^2 \tag{45}$$

Curiously, the same fraction emerges as the ratio between global field intensity and local reactive intensity, specifically:

$$\frac{\delta V}{V} = \frac{3\delta}{R} = \frac{\frac{MG}{R^2}}{\frac{c^2}{R}}$$

and therefore:

$$\delta R = \frac{MG}{3c^2} \tag{46}$$

We begin our expose' with a quote from Richard Feynman. It is fitting we close it likewise:

"No machinery has every been invented that explains gravity without also predicting some other phenomena that does not exist."

Richard Feynman (c) B Jimerson 2014

Interested Readers are invited to send comments to cosmodynamics@yahoo.com